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COMPOSITION AND OCTANE NUMBER OF U.S. MOTOR GASOLINES SAMPLED IN THE DU PONT 1978-79 WINTER ROAD OCTANE SURVEY

Prepared for the Department of Energy
Under Contract No. EW-78-C-19-0012 with
Modification A002

Date Published—September 1979

E. I. du Pont de Nemours and Company, Inc.
Wilmington, Delaware

U. S. DEPARTMENT OF ENERGY

Division of Industrial Energy Conservation

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PLR-79-46

W. L. Johnson July, 1979

Prepared for the Department of Energy
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ABSTRACT

Samples of U. S. Motor Gasoline obtained from service stations in early December, 1978, were composited by region based on company sales. These composited samples were analyzed for hydrocarbon composition, sulfur, manganese, other specifications (distillation, RVP, gum, gravity) and Research and Motor Octane Number.

Petroleum Laboratory
E. I. du Pont de Nemours and Company, Inc.
Wilmington, Delaware 19898

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I. OBJECTIVE

To analyze composited samples of U.S. Motor fuels for hydrocarbon composition, sulfur, manganese, other specifications (distillation, RVP, Gum, gravity) and Research and Motor octane numbers.

II. BACKGROUND

The United States Department of Energy's Bartlesville Energy Research Center requested that Du Pont conduct sulfur, manganese, and hydrocarbon composition analyses of U. S. motor fuels collected from service stations for Du Pont's 1977-78 Winter and 1978 Summer Road Octane Surveys. The request included expansion of the tests to include service station fuels from Salt Lake City and Seattle, which are not included in the Du Pont surveys.

Subsequently, DOE requested that similar analyses be obtained for Du Pont's 1978-79 Winter survey fuels. A proposal for conducting the earlier analyses is set forth in A. J. Pahnke's letter of February 14, 1978 to R. W. Hurn, DOE Bartlesville Energy Research Center. The proposal was accepted by DOE and Contract EW-78-C-19-0012 was executed authorizing the tests. (Appendix 1).

Du Pont's proposal for the 1978-79 Winter survey is contained in E. S. Jacobs' letter of February 26, 1979 to R. W. Hurn (Appendix 2). Results for the 1978-79 Winter fuels are shown in this report.

The 1977-78 Winter tests are reported in Du Pont Report No. PLR-78-35, "Hydrocarbon Composition, Sulfur, and Manganese Content of U. S. Motor Fuels for the Du Pont 1977-78 Winter Road Octane Survey."

The 1978 Summer tests are shown in Du Pont Report No. PLR-78-68, "Hydrocarbon Composition, Sulfur, and Manganese Content of U. S. Motor Fuels Sampled for the Du Pont 1978 Summer Road Octane Survey."

III. SUMMARY OF FINDINGS

A. Hydrocarbon Composition - Average aromatic contents are 23 and 24 volume percent, respectively, for

leaded regular and leaded premium and 28 volume percent for unleaded regular. Olefin contents are 5 volume percent in each gasoline grade.

Average benzene content is about one volume percent in each grade and ranges from a low of 0.35 percent to a high of 1.69 percent, both extremes in unleaded regular. Average unleaded regular contains 1.04 volume percent benzene, leaded regular 1.19 volume percent, and leaded premium 0.90 volume percent.

B. Manganese, Lead and Sulfur Content - Average manganese contents are negligible in both leaded grades. Manganese concentration is 0.005 g/gal in regular and 0.001 g/gal in premium. Unleaded regular was not measured for manganese.

Lead contents are 1.74 g Pb/gal in regular and 2.17 g Pb/gal in premium. Overall pool lead concentrations are lowest on the West Coast (Areas 7 and 8) at 0.76 g/gal and highest on the East Coast (Areas 1 and 2) at 1.72 g/gal.

Average sulfur concentrations are as follows:

	Sulfur, Wt. Percent	
	ASTM D3120	ASTM D1266
Unleaded Regular	0.021	-
Leaded Regular	-	0.034
Leaded Premium		0.019

C. Octane Numbers - Overall average octane numbers are shown in the table below. Average data include fuels from Denver and Salt Lake City which are by design of lower quality because of altitude considerations in these locations.

	Average Octane Numbers		
	Research	Motor	(R+M)/2
Unleaded Regular	92.5	83.8	88.2
Leaded Regular	92.9	85.6	89.2
Leaded Premium	97.8	89.8	93.8

IV. EXPERIMENTAL

A. Sample Preparation - A total of 256 U. S. motor fuels obtained at service stations in early December, 1978, were composited on regional and market share bases for sulfur, manganese, and hydrocarbon composition analyses. The fuels were obtained in the following city markets: Atlanta, Jacksonville, Miami, Newark, N.J., Philadelphia, Detroit, Chicago, Kansas City, Wichita, Oklahoma City, Tulsa, Houston, New Orleans, Denver, Los Angeles, San Francisco, Salt Lake City and Seattle.

As agreed, the samples were segregated regionally into eight areas. Gasolines in each of the eight regions were composited by grade on a market share basis for an overall total of twenty-four test fuels. City-market areas and individual gasoline samples included in each composite sample are shown in Table I.

Calculations for each area, shown in Tables 2-9 illustrate how each area composite sample was prepared. The composite fractions in the last column of each table represent the portion of a company's gasoline sample used to make up an area composite sample for each of the three gasoline grades, unleaded regular, leaded regular, and leaded premium. We assumed that a given company market share was the same for each grade. This assumption may not be correct but we have no data on which to apportion a company market share by grade in each area. The state gasoline sales and company market share data were obtained from the National Petroleum News Fact Book, Mid-May, 1978.

B. Analyses - Manganese analyses were determined by Du Pont M180 Atomic Absorption Method and were measured in leaded fuels only. Other specification analyses included ASTM D86 distillation, Reid Vapor Pressure by ASTM D323, gum by ASTM D381, °API gravity, sulfur by ASTM D3120 for unleaded gasolines and by ASTM D1266 for leaded gasolines, and lead content by atomic absorption, and octane numbers by ASTM D2699 Research and ASTM D2700 Motor. These inspection data are shown in Tables 10-13.

Hydrocarbon composition was determined by gas chromatography using Du Pont's Gas Chromatogram Octane Profile (GCOP) procedure, Du Pont Report No. PLMR-24-78. Hydrocarbon data are summarized in Table 14 and shown in detail in the following tables:

Unleaded Regular - Tables 15-1, 15-2, 15-3, 15-4.
Leaded Regular - Tables 16-1, 16-2, 16-3, 16-4.
Leaded Premium - Tables 17-1, 17-2, 17-3, 17-4.

Data in the above tables also include the following information:

1. Concentration by volume of the hydrocarbon components from 3 to 10+ carbon atoms per molecule.

2. Composition classifications into isoparaffin, normal paraffin, naphthene, olefin, aromatic, and unknown hydrocarbons.

3. Linearly calculated values for specific gravity, molecular weight, Research and Motor octane numbers both clear and with 3 ml TEL per gallon, and a C/H weight ratio.

4. Corrected Research and Motor octane numbers, both clear and with 3 ml TEL per gallon, based on correlations of calculated and measured octane numbers.

Table 1

AREA DESIGNATION AND CITY MARKETS

Composite Sample Area Number	City Markets	Number of Samples in Gasoline Grade Composition		
		Unleaded Regular	Leaded Regular	Leaded Premium
1	Atlanta, Jacksonville, Miami	89	8	5
2	Newark, Philadelphia	20	18	14
3	Detroit, Chicago, Kansas City	19	19	10
4	Wichita, Oklahoma City, Tulsa	12	12	8
5	Houston, New Orleans	9	9	8
6	Denver, Salt Lake City	9	9	8
7	Los Angeles, San Francisco	13	10	12
8	Seattle	5	5	5
	Total	96	90	70

Table 2

EXAMPLE CALCULATION OF COMPOSITE GASOLINE SAMPLE FOR DOE PROGRAM

Area 1, 1978-79 Winter Survey

Company	State	Total State Gasoline gals x 10^6	Company Share State Market %	Company Share State Market gals x 10^6	Area Total gals x 10^6	Fraction of Area Composite
1-A	GA	3,002	4.07	122.2		
	FL	4,669	6.57	306.8	429.0	0.12
1-B	GA	3,002	11.20	336.2		
	FL	4,669	10.65	497.2	833.4	0.23
1-C	GA	3,002	8.14	244.4		
	FL	4,669	7.89	368.4	612.8	0.17
1-D	GA	3,002	4.00	120.1		
	FL	4,669	-*	-	120.1	0.03
1-E	GA	3,002	4.79	143.8		
	FL	4,669	-*	-	143.8	0.04
1-F	GA	3,002	3.09	92.8		
	FL	4,669	4.50	210.1	302.9	0.08
1-G	GA	3,002	5.39	161.8		
	FL	4,669	8.43	396.0	557.8	0.15
1-H	GA	3,002	-*	-		
	FL	4,669	3.49	162.9	162.9	0.05
1-I	GA	3,002	6.18	185.5		
	FL	4,669	5.75	268.5	454.0	0.13
				Total	3,616.7	

$$\text{Company Fraction of Area Composite} = \frac{\text{Company Area Total Gallons}}{\text{Total Area Gallons}}$$

*Does not market in these states or sales data were not available.

Table 3

EXAMPLE CALCULATION OF COMPOSITE GASOLINE SAMPLE FOR DOE PROGRAM

Area 2, 1978-79 Winter Survey

Company	State	Total State Gasoline gals x 10^6	Company Share State Market %	Company Share State Market gals x 10^6	Area Total gals x 10^6	Fraction of Area Composite
2-A-1	NJ	3,453	20.56	709.9	709.9	0.10
-2	PA	5,156	10.35	533.6	533.6	0.07
2-B-1	NJ	3,453	5.47	188.9	188.9	0.03
-2	PA	5,156	6.33	191.5	191.5	0.03
2-C	NJ	3,453	5.10	176.1		
	PA	5,156	7.17	369.7	545.8	0.08
2-D-1	NJ	3,453	7.09	244.8	244.8	0.03
-2	PA	5.156	6.69	344.9	344.9	0.05
2-E-1	NJ	3,453	8.34	288.0	288.0	0.04
-2	PA	5,156	8.34	430.0	430.0	0.06
2-F-1	NJ	3,453	1.67	57.7	57.7	0.01
-2	PA	5,156	1.67	86.1	86.1	0.01
2-G-1	NJ	3,453	6.84	236.2		
-2	PA	5,156	6.62	341.3	577.5	0.08
2-H-1	NJ	3,453	8.63	298.0	298.0	0.04
-2	PA	5,156	9.00	464.0	464.0	0.07
2-I	NJ	3,453	4.75	164.0		
	PA	5,156	4.75	244.9	408.9	0.06
2-J-1	NJ	3,453	3.71	128.1	128.1	0.02
-2	PA	5,156	15.71	810.0	810.0	0.12
2-K	NJ	3,453	1.97	68.0		
	PA	5,156	1.97	68.0	136.0	0.02
2-L	NJ	3,453	6.02	207.9		
	PA	5,156	7.58	339.1	547.0	0.08
				Total	6,990.7	

$$\text{Company Fraction of Area Composite} = \frac{\text{Company Area Total Gallons}}{\text{Total Area Gallons}}$$

Table 4

EXAMPLE CALCULATION OF COMPOSITE GASOLINE SAMPLE FOR DOE PROGRAM

Area 3, 1978-79 Winter Survey

Company	State	Total State Gasoline gals x 10^6	Company Share State Market %	Company Share State Market gals x 10^6	Area Total gals x 10^6	Fraction of Area Composite
3-A	MI	4,888	3.03	148.1	148.1	0.02
	IL	5,436	-*	-	-	-
	KS	1,384	-*	-	-	-
3-B	MI	4,888	2.98	145.7	145.7	0.02
	IL	5,436	-	-	-	-
	KS	1,384	-	-	-	-
3-C	MK	4,888	4.80	234.6		
	IL	5,436	5.57	302.8		
	KS	1,384	3.46	47.9	585.3	0.08
3-D-1	MI	4,888	14.67	717.1	717.1	0.09
-2	IL	5,436	18.28	993.7	993.7	0.13
-3	KS	1,384	11.26	155.8	155.8	0.02
3-E-1	MI	4,888	3.39	165.7	165.7	0.02
-2	IL	5,436	2.49	135.4	135.4	0.02
	KS	1,384	-*	-	-	-
3-F	MI	4,888	6.57	321.1		
	IL	5,436	4.46	242.4		
	KS	1,384	4.23	58.5	622.0	0.08
3-G	MI	4,888	6.30	307.9		
	IL	5,436	3.10	168.5		
	KS	1,384	1.57	21.7	498.1	0.07
3-H	MI	4,888	7.02	343.1		
	IL	5,436	3.20	174.0	517.1	0.07
	KS	1,384	-*	-	-	-
3-I-1	MI	4,888	5.72	279.6	279.6	0.04
-2	IL	5,436	5.44	295.7	295.7	0.04
	KS	1,384	-	-	-	
3-J-1(a)	MI	4,888	5.18	253.2	253.2	0.03
-2(a)	IL	5,436	5.02	272.9	272.9	0.04
	KS	1,384	-*	-	-	-
3-K	MI	4,888	-*	-	-	-
	IL	5,436	3.03	164.7		
	KS	1,384	1.22	16.9	181.6	0.02
3-L	MI	4,888	10.55	515.7		
	IL	5,436	10.56	574.0	1,089.7	0.14
	KS	1,384	-*	-	-	-
3-M	MI	4,888	-*			
	IL	5,436	4.62	251.1	251.1	0.03
	KS	1,384	-*	-	-	-
3-N	MI	4,888	-*	-	-	-
	IL	5,436	4.22	229.4		
	KS	1,384	6.85	94.8	324.2	0.04
				Total	7,632.0	

$$\text{Company Fraction of Area Composite} = \frac{\text{Company Area Total Gallons}}{\text{Total Area Gallons}}$$

(a) Does not market unleaded regular.

* Does not market in these states or sales data were not available.

Table 5

EXAMPLE CALCULATION OF COMPOSITE GASOLINE SAMPLE FOR DOE PROGRAM

Area 4, 1978-79 Winter Survey

Company	State	Total State Gasoline gals x 10^6	Company Share State Market %	Company Share State Market gals x 10^6	Area Total gals x 10^6	Fraction of Area Composite
4-A	KS	1,384	4.40	60.9		
	OK	1,894	0.50	9.5	70.4	0.06
4-B	KS	1,384	5.77	79.9		
	OK	1,894	2.17	41.1	121.0	0.10
4-C-1	KS	1,384	2.70	37.4	37.4	0.03
-2	OK	1,894	6.96	131.8	131.8	0.10
4-D	KS	1,384	6.06	83.9	83.9	0.07
	OK	1,894	-*	-	-	-
4-E	KS	1,384	6.23	86.2	86.2	0.07
	OK	1.894	-*	-	-	-
4-F	KS	1,384	2.72	37.6		
	OK	1,894	3.47	65.7	103.3	0.08
4-G	KS	1,384	3.09	42.8		
	OK	1,894	3.00	56.8	89.6	0.07
4-H	KS	1,384	7.74	107.1		
	OK	1,894	1.80	34.1	141.2	0.11
4-I	KS	1,384	-*	-	-	-
	OK	1,894	0.50	6.9	6.9	0.01
4-J	KS	1,384	-*	-	-	-
	OK	1,894	7.87	149.0	149.0	0.12
4-K	KS	1,384	3.46	47.9		
	OK	1,894	9.56	181.1	229.0	0.18
				Total	1,249.7	

$$\text{Company Fraction of Area Composite} = \frac{\text{Company Area Total Gallons}}{\text{Total Area Gallons}}$$

* Does not market in these states or sales data were not available.

Table 6

EXAMPLE CALCULATION OF COMPOSITE GASOLINE SAMPLE FOR DOE PROGRAM

Area 5, 1978-79 Winter Survey

Company	State	Total State Gasoline gals x 10^6	Company Share State Market %	Company Share State Market gals x 10^6	Area Total gals x 10^6	Fraction of Area Composite
5-A	LA	2,080	3.77	78.4		
	TX	8,423	3.00	252.6	331.0	0.06
5-B-1	LA	2,080	6.37	132.5	132.5	0.02
-2	TX	8,423	10.19	858.3	858.3	0.15
5-C	LA	2,080	6.04	125.6	125.6	0.02
	TX	8,423	-*	-	-	-
5-D	LA	2,080	5.30	110.2		
	TX	8,423	2.42	203.8	314.0	0.06
5-E	LA	2,080	5.81	120.8		
	TX	8,423	4.76	400.9	521.7	0.09
5-F	LA	2,080	3.61	75.1		
	TX	8,423	6.43	541.6	616.7	0.11
5-G	LA	2,080	7.87	163.7		
	TX	8,423	13.28	1,118.6	1,282.3	0.22
5-H	LA	2,080	17.02	354.0		
	TX	8,423	14.16	1,192.7	1,546.7	0.27
				Total	5,728.8	

$$\text{Company Fraction of Area Composite} = \frac{\text{Company Area Total Gallons}}{\text{Total Area Gallons}}$$

*Does not market in Texas or sales data were not available.

Table 7

EXAMPLE CALCULATION OF COMPOSITE GASOLINE SAMPLE FOR DOE PROGRAM

Area 6, 1978-79 Winter Survey

Company	State	Total State Gasoline gals x 10^6	Company Share State Market %	Company Share State Market gals x 10^6	Area Total gals x 10^6	Fraction of Area Composite
6-A	CO	1,416	1.59	22.5	22.5	0.03
	UT	0,715	-*	-	-	-
6-B	CO	1,416	2.11	29.9	29.9	0.03
	UT	0,715	-*	-	-	-
6-C	CO	1,416	4.28	60.6	60.6	0.07
	UT	0,715	-*	-	-	-
6-D-1	CO	1,416	5.66	80.1	80.1	0.09
-2	UT	0,715	5.69	40.7	40.7	0.05
6-E	CO	1,416	9.56	135.4		
	UT	0,715	11.09	79.3	214.7	0.23
6-F	CO	1,416	5.21	73.8		
	UT	0,715	12.83	91.7	165.5	0.19
6-G	CO	1,416	8.17	115.7		
	UT	0,715	5.89	42.1	157.8	0.18
6-H	CO	1,416	3.39	48.0		
	UT	0,715	9.16	65.5	113.5	0.13
				Total	885.3	

$$\text{Company Fraction of Area Composite} = \frac{\text{Company Area Total Gallons}}{\text{Total Area Gallons}}$$

*Does not market in Utah or sales data were not available.

Table 8

EXAMPLE CALCULATION OF COMPOSITE GASOLINE SAMPLE FOR DOE PROGRAM

Area 7, 1978-79 Winter Survey

Company	State	Total State Gasoline gals x 10^6	Company Share State Market %	Company Share State Market gals x 10^6	Area Total gals x 10^6	Fraction of Area Composite
7-A	CA	11,292	2.18	492.4	492.4	0.06
7-B-1*	CA	"	3.79	428.0	428.0	0.05
-2*	CA	"	3.80	429.1	429.1	0.05
7-C-1*	CA	"	8.24	930.5	930.5	0.10
-2*	CA	"	8.24	930.5	930.5	0.10
7-D	CA	"	4.76	537.5	537.5	0.06
7-E	CA	"	3.26	368.1	368.1	0.04
7-F-1	CA	"	8.02	905.6	905.6	0.10
-2	CA	"	8.03	906.7	906.7	0.10
7-G	CA	"	1.87	211.2	211.2	0.02
7-H	CA	"	6.95	784.8	784.8	0.09
7-I	CA	"	11.22	1,267.0	1,267.0	0.15
7-J	CA	"	5.98	675.3	675.3	0.08
				Total	8,866.7	

$$\text{Company Fraction of Area Composite} = \frac{\text{Company Area Total Gallons}}{\text{Total Area Gallons}}$$

*More than one sample for these companies were taken in the state of California. The total percent of the company state market was apportioned evenly for these gasoline samples. For example, Company B has 7.59% of the total state market. One-half of this was apportioned to each sample.

Table 9

EXAMPLE CALCULATION OF COMPOSITE GASOLINE SAMPLE FOR DOE PROGRAM

Area 8, 1978-79 Winter Survey

Company	State	Total State Gasoline gals x 10^6	Company Share State Market %	Company Share State Market gals x 10^6	Area Total gals x 10^6	Fraction of Area Composite
8-A	WA	1,944	10.64	206.8	206.8	0.19
8-B	WA	1,944	7.37	143.3	143.3	0.13
8-C	WA	1,944	14.84	288.5	288.5	0.28
8-D	WA	1,944	9.98	194.0	194.0	0.18
8-E	WA	1,944	11.98	232.9	232.9	0.22
				Total	1,065.5	

$$\text{Company Fraction of Area Composite} = \frac{\text{Company Area Total Gallons}}{\text{Total Area Gallons}}$$

COMPOSITED FUEL INSPECTION DATA

	Atlanta, Jacksonville, Miami Area 1			Newark, N.J., Philadelphia Area 2		
	Unleaded Regular	Leaded Regular	Leaded Premium	Unleaded Regular	Leaded Regular	Leaded Premium
Gum, ASTM, D381, Mg	1	0	0	1	1	0
RVP, ASTM, D323, lb	11.0	10.7	10.5	12.5	12.1	12.3
Gravity, °API	57.3	62.4	61.9	59.1	62.8	61.8
Sulfur, Wt. %						
ASTM D3120	0.020	-	-	0.018	-	-
ASTM D1266	-	0.039	0.018	-	0.034	0.017
Manganese, g/gal(1)	-	0.004	0	-	0.006	0.002
Lead, g Pb/gal(2)	-	2.35	2.77	-	2.15	2.72
Distillation, ASTM D86						
IBP, °F	85	90	87	84	85	81
5% Evap., °F	100	103	103	94	98	93
10%	114	114	114	106	108	106
20%	137	134	135	129	128	128
30%	167	154	157	157	152	152
40%	196	179	183	190	177	179
50%	225	202	209	222	205	209
60%	250	230	231	250	235	239
70%	278	267	261	278	269	271
80%	309	307	295	309	306	305
90%	347	355	346	343	348	338
95%	372	386	377	372	381	368
End Point, °F	421	414	422	421	419	415
Recovery, Vol. %	98.0	98.0	98.0	98.0	98.0	98.0
Residue, Vol. %	1.0	1.0	1.0	1.0	1.0	1.0
Loss, Vol. %	1.0	1.0	1.0	1.0	1.0	1.0
Research O.N.	93.1	92.9	97.4	92.6	93.1	97.8
Motor O.N.	84.0	86.1	89.9	83.7	86.6	90.0

(1) Du Pont M180 Method.
(2) Atomic Absorption

Table 10

COMPOSITED FUEL INSPECTION DATA

	Detroit, Chicago, Kansas City Area 3			Wichita, Oklahoma City, Tulsa Area 4		
	Unleaded Regular	Leaded Regular	Leaded Premium	Unleaded Regular	Leaded Regular	Leaded Premium
Gum, ASTM, D381, Mg	1	1	0	1	1	0
RVP, ASTM, D323, lb	12.5	12.0	11.6	11.1	11.4	11.0
Gravity, °API	62.2	61.7	62.3	64.3	63.4	65.5
Sulfur, Wt. %						
ASTM D3120	0.038	-	-	0.017	-	-
ASTM D1266	-	0.056	0.024	-	0.026	0.017
Manganese, g/gal(1)	-	0.017	0.004	-	0	0
Lead, g Pb/gal(2)	-	1.80	2.14	-	1.83	2.38
Distillation, ASTM D86						
IBP, °F	84	86	85	87	86	85
5% Evap., °F	93	96	98	97	99	101
10%	106	108	110	111	110	114
20%	128	128	131	137	128	138
30%	154	152	157	167	148	164
40%	182	179	183	197	171	191
50%	209	207	211	219	194	212
60%	233	232	234	235	220	227
70%	257	263	261	254	250	247
80%	292	300	295	285	286	273
90%	338	348	342	330	333	322
95%	372	388	379	372	368	358
End Point, °F	426	426	416	420	414	407
Recovery, Vol. %	97.0	98.0	98.0	97.0	98.0	98.0
Residue, Vol. %	1.0	1.0	1.0	1.0	1.0	1.0
Loss, Vol. %	2.0	1.0	1.0	2.0	1.0	1.0
Research O.N.	92.3	92.9	98.1	91.6	92.6	98.7
Motor O.N.	83.9	85.6	90.2	84.2	85.4	92.2

(1) Du Pont M180 Method.
(2) Atomic Absorption

Table 11

COMPOSITED FUEL INSPECTION DATA

	Houston, New Orleans Area 5			Denver, Salt Lake City Area 6		
	Unleaded Regular	Leaded Regular	Leaded Premium	Unleaded Regular	Leaded Regular	Leaded Premium
Gum, ASTM, D381, Mg	1	3	0	1	1	0
RVP, ASTM, D323, lb	11.4	11.1	11.1	12.0	11.8	12.1
Gravity, °API	60.1	62.7	61.8	63.8	65.4	65.0
Sulfur, Wt. %						
ASTM D3120	0.020	-	-	0.023	-	-
ASTM D1266	-	0.038	0.024	-	0.024	0.020
Manganese, g/gal[1]	-	0.002	0	-	0	0
Lead, g Pb/gal[2]	-	2.34	2.65	-	1.34	1.58
Distillation, ASTM D86						
IBP, °F	86	87	87	85	83	81
5% Evap., °F	99	100	100	99	97	96
10%	111	110	110	111	109	110
20%	135	130	130	135	135	136
30%	164	152	153	163	149	166
40%	195	177	179	190	169	193
50%	222	203	209	213	192	217
60%	246	233	235	234	217	235
70%	269	265	263	259	245	255
80%	303	302	296	291	280	284
90%	338	343	337	333	325	329
95%	369	376	367	379	358	370
End Point, °F	415	415	410	412	401	415
Recovery, Vol. %	98.0	98.0	98.0	98.0	98.0	98.0
Residue, Vol. %	1.0	1.0	1.0	1.0	1.0	1.0
Loss, Vol. %	1.0	1.0	1.0	1.0	1.0	1.0
Research O.N.	93.0	93.5	97.9	90.0	91.7	96.8
Motor O.N.	84.5	86.5	89.8	81.2	84.1	88.4

(1) Du Pont M180 Method.
(2) Atomic Absorption.

Table 12

COMPOSITED FUEL INSPECTION DATA

	Los Angeles, San Francisco Area 7			Seattle Area 8		
	Unleaded Regular	Leaded Regular	Leaded Premium	Unleaded Regular	Leaded Regular	Leaded Premium
Gum, ASTM, D381, Mg	0	0	0	1	0	0
RVP, ASTM, D323, lb	12.9	9.2	10.3	10.5	13.0	12.5
Gravity, °API	59.5	57.8	59.6	56.4	61.8	62.1
Sulfur, Wt. %						
ASTM D3120	0.013	-	-	0.016	-	-
ASTM D1266	-	0.035	0.018	-	0.024	0.012
Manganese, g/gal(1)	-	0.013	0	-	0	0
Lead, g Pb/gal(2)	-	1.06	1.90	-	1.09	1.20
Distillation, ASTM D86						
IBP, °F	85	91	87	91	79	80
5% Evap., °F	96	102	103	106	90	92
10%	107	120	117	121	102	104
20%	133	146	140	147	124	126
30%	164	169	164	176	148	153
40%	196	194	189	203	173	179
50%	222	220	213	227	203	205
60%	244	248	236	248	232	230
70%	269	277	263	272	268	256
80%	298	311	293	300	305	286
90%	334	350	333	332	352	324
95%	368	377	361	361	386	357
End Point, °F	420	419	406	408	423	404
Recovery, Vol. %	98.0	98.5	98.5	98.0	98.0	98.0
Residue, Vol. %	1.0	1.0	1.0	1.0	1.0	1.0
Loss, Vol. %	1.0	0.5	0.5	1.0	1.0	1.0
Research O.N.	94.3	93.7	98.0	93.0	92.6	97.8
Motor O.N.	84.4	85.1	89.1	84.4	85.3	89.1

(1) Du Pont M180 Method.
(2) Atomic Absorption

Table 13

Table 14

SUMMARY OF TOTAL VOLUME PERCENT HYDROCARBONS

Area	Paraffins			Olefin	Aromatic	Unknown
	Iso	Normal	Naph			
			Unleaded Regular			
1	39.15	17.51	5.21	5.05	30.41	2.67
2	37.63	18.49	4.55	5.06	31.80	2.46
3	43.17	18.69	4.75	5.67	24.82	2.89
4	51.32	17.45	4.71	4.98	19.21	2.33
5	39.49	20.03	4.53	5.39	28.76	1.81
6	42.61	20.57	5.97	8.86	19.82	2.18
7	37.38	14.25	5.38	4.44	36.66	1.89
8	37.50	21.50	4.05	3.19	32.02	1.73
Avg.	41.03	18.56	4.89	5.33	27.94	2.24
			Leaded Regular			
1	37.65	24.90	7.68	4.87	21.13	3.77
2	36.61	25.34	7.26	4.45	22.68	3.66
3	34.40	25.45	7.97	4.94	23.70	3.54
4	34.53	26.22	9.18	5.11	22.06	2.90
5	37.68	24.46	6.29	5.12	22.95	3.49
6	35.91	27.35	8.61	7.25	19.14	1.74
7	33.71	18.62	9.64	6.04	28.72	3.28
8	32.74	24.62	9.57	5.07	23.94	4.06
Avg.	35.40	24.62	8.28	5.36	23.04	3.30
			Leaded Premium			
1	46.74	17.85	6.42	3.40	22.75	2.85
2	39.31	22.31	5.45	4.32	25.78	2.84
3	44.73	18.94	4.88	4.49	23.79	3.18
4	53.57	18.21	4.66	3.96	17.57	2.04
5	41.21	21.67	4.80	4.94	25.30	2.08
6	48.41	19.37	4.84	6.65	18.33	2.41
7	40.92	15.32	8.20	4.77	28.40	2.40
8	40.76	20.25	5.88	5.11	26.60	1.40
Avg.	44.46	19.24	5.64	4.70	23.56	2.40

Table 15-1

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY UNLEADED REG. AREA 1

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.13	.00	.00	.00	.00	.13
4.	1.48	7.91	.00	.35	.00	.00	9.74
5.	9.52	4.84	.38	1.95	.00	.00	16.69
6.	7.73	2.23	1.63	1.62	.90	.00	14.12
7.	6.25	1.21	1.55	.74	5.85	.00	15.61
8.	10.47	.55	.96	.37	6.99	.00	19.33
9.	2.42	.28	.60	.02	9.55	.00	12.87
10+	1.28	.35	.09	.00	7.12	2.67	11.51
TOTAL	39.15	17.51	5.21	5.05	30.41	2.67	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7366	60.6	94.6	87.7	101.2	83.1	96.8	6.78
PREDICTED O.N.				93.3	*	84.5	94.3	

* CORRELATIONS NOT APPLICABLE

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY UNLEADED REG. AREA 2

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.21	.00	.00	.00	.00	.21
4.	2.49	8.49	.00	.48	.00	.00	11.46
5.	9.66	4.66	.37	2.11	.00	.00	16.80
6.	7.80	2.34	1.39	1.54	1.31	.00	14.38
7.	5.80	1.38	1.18	.62	5.68	.00	14.66
8.	8.46	.69	.81	.30	9.78	.00	20.03
9.	2.20	.33	.65	.01	8.40	.00	11.60
10+	1.23	.40	.15	.00	6.63	2.46	10.87
TOTAL	37.63	18.49	4.55	5.06	31.80	2.46	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7355	60.9	93.1	86.8	100.5	82.4	96.4	6.86
PREDICTED O.N.				92.8	100.5	84.1	93.9	

Table 15-2

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY UNLEADED REG. AREA 3

	---PARAFFIN---						
CARBON	ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.11	.00	.00	.00	.00	.11
4.	1.68	10.49	.00	.36	.00	.00	12.53
5.	9.69	3.82	.32	2.30	.00	.00	16.13
6.	7.36	1.84	1.53	2.00	.85	.00	13.59
7.	7.91	1.29	1.30	.66	5.81	.00	16.97
8.	12.59	.56	.76	.30	7.04	.00	21.25
9.	2.31	.21	.61	.02	5.62	.00	8.78
10+	1.62	.38	.23	.02	5.50	2.89	10.64
TOTAL	43.17	18.69	4.75	5.67	24.82	2.89	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7243	63.9	92.6	87.3	101.1	83.0	97.1	6.55
PREDICTED O.N.				93.1	*	84.4	94.5	

* CORRELATIONS NOT APPLICABLE

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY UNLEADED REG. AREA 4

	---PARAFFIN---						
CARBON	ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.04	.00	.00	.00	.00	.04
4.	1.59	10.45	.00	.46	.00	.00	12.50
5.	8.16	3.23	.25	1.85	.00	.00	13.49
6.	5.83	1.34	1.24	1.72	.35	.00	10.50
7.	10.71	1.13	1.17	.57	3.70	.00	17.29
8.	19.64	.65	.97	.33	6.24	.00	27.83
9.	2.99	.28	.84	.02	4.68	.00	8.80
10+	2.41	.32	.23	.02	4.25	2.33	9.55
TOTAL	51.32	17.45	4.71	4.98	19.21	2.33	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
IEAR CALC.	.7166	66.0	94.4	86.1	100.6	82.7	97.6	6.25
PREDICTED O.N.				92.4	100.6	84.3	94.8	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY UNLEADED REG. AREA 5

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.10	.00	.00	.00	.00	.10
4.	1.18	10.20	.00	.35	.00	.00	11.73
5.	9.17	4.80	.38	2.04	.00	.00	16.38
6.	7.42	2.39	1.19	1.68	1.07	.00	13.75
7.	6.46	1.34	1.25	.94	5.15	.00	15.14
8.	11.29	.61	1.01	.35	8.85	.00	22.10
9.	2.63	.27	.59	.02	8.11	.00	11.62
10+	1.34	.33	.11	.02	5.59	1.81	9.19
TOTAL	39.49	20.03	4.53	5.39	28.76	1.81	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7298	62.4	92.9	87.2	100.9	82.9	97.0	6.71
PREDICTED O.N.				93.0	100.9	84.4	94.4	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY UNLEADED REG. AREA 6

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.30	.00	.00	.00	.00	.30
4.	1.21	10.06	.00	.78	.00	.00	12.05
5.	7.44	4.08	.29	3.28	.00	.00	15.09
6.	6.82	2.29	1.58	2.96	.54	.00	14.20
7.	8.83	1.87	1.63	1.27	3.76	.00	17.36
8.	13.09	1.05	1.30	.49	6.52	.00	22.44
9.	3.12	.46	1.09	.05	4.83	.00	9.55
10+	2.10	.45	.09	.03	4.17	2.18	9.02
TOTAL	42.61	20.57	5.97	8.86	19.82	2.18	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7175	65.7	92.7	82.8	97.7	78.8	94.1	6.32
PREDICTED O.N.				90.6	98.2	82.5	92.2	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY UNLEADED REG. AREA 7

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.21	.00	.00	.00	.00	.21
4.	2.14	6.35	.00	.44	.00	.00	8.92
5.	8.98	3.06	.33	1.89	.00	.00	14.26
6.	7.58	1.91	2.25	1.48	1.58	.00	14.80
7.	7.21	1.45	1.74	.42	7.92	.00	18.75
8.	8.78	.74	.64	.20	12.27	.00	22.64
9.	1.74	.29	.36	.00	8.52	.00	10.91
10+	.95	.24	.06	.00	6.37	1.89	9.51
TOTAL	37.38	14.25	5.38	4.44	36.66	1.89	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7479	57.7	94.4	88.6	101.8	83.8	97.3	7.12
PREDICTED O.N.				93.8	*	84.8	94.7	

* CORRELATIONS NOT APPLICABLE

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY UNLEADED REG. AREA 8

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.22	.00	.00	.00	.00	.22
4.	1.88	11.90	.00	.34	.00	.00	14.13
5.	7.52	3.91	.36	1.34	.00	.00	13.13
6.	7.13	2.69	1.76	.97	1.69	.00	14.23
7.	8.26	1.51	1.03	.40	6.80	.00	18.00
8.	9.74	.75	.51	.14	10.80	.00	21.93
9.	1.71	.30	.29	.00	7.41	.00	9.72
10+	1.26	.21	.11	.00	5.33	1.73	8.64
TOTAL	37.50	21.50	4.05	3.19	32.02	1.73	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7337	61.4	91.8	87.6	101.4	83.3	97.6	6.90
PEDICTED O.N.				93.3	*	84.6	94.9	

* CORRELATIONS NOT APPLICABLE

Table 16-1

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED REGULAR AREA 1

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.12	.00	.00	.00	.00	.12
4.	1.06	7.98	.00	.27	.00	.00	9.31
5.	8.35	7.37	.62	1.61	.00	.00	17.96
6.	10.74	4.64	2.42	1.55	1.19	.00	20.54
7.	6.75	2.46	2.20	.86	3.01	.00	15.28
8.	6.31	1.07	1.11	.49	5.38	.00	14.37
9.	2.76	.51	1.15	.03	5.60	.00	10.06
10+	1.68	.75	.17	.05	5.95	3.77	12.37
TOTAL	37.65	24.90	7.68	4.87	21.13	3.77	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7217	64.6	93.1	76.9	93.8	73.7	90.6	6.36
PREDICTED O.N.				*	95.0	80.0	89.5	

* CORRELATIONS NOT APPLICABLE

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED REGULAR AREA 2

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.18	.00	.00	.00	.00	.18
4.	2.29	8.38	.00	.44	.00	.00	11.12
5.	8.70	7.29	.59	1.42	.00	.00	17.99
6.	9.87	4.62	2.19	1.14	1.03	.00	18.85
7.	6.17	2.27	2.06	.91	3.54	.00	14.96
8.	5.14	1.16	1.01	.46	6.27	.00	14.04
9.	2.59	.60	1.07	.02	5.76	.00	10.04
10+	1.86	.83	.35	.06	6.07	3.66	12.82
TOTAL	36.61	25.34	7.26	4.45	22.68	3.66	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7216	64.6	92.4	77.4	94.1	74.0	90.8	6.42
PREDICTED O.N.				87.6	95.2	80.2	89.6	

Table 16-2

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED REGULAR AREA 3

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.10	.00	.00	.00	.00	.10
4.	1.52	10.20	.00	.35	.00	.00	12.07
5.	8.26	6.27	.50	1.75	.00	.00	16.78
6.	8.90	4.27	2.87	1.44	1.37	.00	18.85
7.	6.36	2.39	2.51	.94	4.70	.00	16.90
8.	5.54	1.07	1.01	.41	6.78	.00	14.82
9.	2.40	.46	.94	.02	5.45	.00	9.27
10+	1.41	.69	.14	.03	5.40	3.54	11.21
TOTAL	34.40	25.45	7.97	4.94	23.70	3.54	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7240	63.9	91.6	79.0	95.2	75.2	91.6	6.51
PREDICTED O.N.				88.4	96.1	80.8	90.3	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED REGULAR AREA 4

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.10	.00	.00	.00	.00	.10
4.	1.10	8.56	.00	.37	.00	.00	10.03
5.	8.90	7.98	.65	1.82	.00	.00	19.35
6.	9.29	4.84	3.59	1.52	1.05	.00	20.30
7.	6.57	2.55	2.78	.94	4.27	.00	17.11
8.	4.85	1.06	1.08	.39	6.54	.00	13.93
9.	2.31	.50	.94	.03	5.15	.00	8.93
10+	1.50	.62	.14	.04	5.06	2.90	10.26
TOTAL	34.53	26.22	9.18	5.11	22.06	2.90	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7212	64.7	91.2	77.6	94.4	74.0	90.8	6.44
PREDICTED O.N.				87.6	95.4	80.2	89.6	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED REGULAR AREA 5

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.09	.00	.00	.00	.00	.09
4.	1.01	8.77	.00	.28	.00	.00	10.06
5.	8.56	6.53	.56	1.63	.00	.00	17.28
6.	10.91	4.35	1.76	1.68	1.18	.00	19.88
7.	7.39	2.33	1.62	1.07	3.88	.00	16.29
8.	5.38	1.08	.99	.38	6.53	.00	14.36
9.	2.58	.54	1.03	.03	5.45	.00	9.62
10+	1.85	.78	.34	.05	5.90	3.49	12.42
TOTAL	37.68	24.46	6.29	5.12	22.95	3.49	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7230	64.2	92.8	77.5	94.2	74.1	91.0	6.45
PREDICTED O.N.				87.6	95.3	80.3	89.7	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED REGULAR AREA 6

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.27	.00	.00	.00	.00	.27
4.	1.19	8.45	.00	.82	.00	.00	10.46
5.	8.67	7.78	.50	2.90	.00	.00	19.85
6.	9.41	5.65	3.20	1.88	1.02	.00	21.17
7.	6.36	2.84	2.65	1.16	4.10	.00	17.11
8.	5.98	1.30	1.05	.43	5.96	.00	14.71
9.	2.76	.59	1.09	.04	4.36	.00	8.86
10+	1.53	.46	.11	.03	3.70	1.74	7.58
TOTAL	35.91	27.35	8.61	7.25	19.14	1.74	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7129	67.0	89.7	76.0	93.4	72.5	89.9	6.31
PREDICTED O.N.				*	94.7	79.5	89.0	

* CORRELATIONS NOT APPLICABLE

Table 16-4

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED REGULAR AREA 7

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.14	.00	.00	.00	.00	.14
4.	1.37	5.17	.00	.49	.00	.00	7.03
5.	8.11	5.40	.69	2.22	.00	.00	16.42
6.	8.87	3.75	3.89	1.90	1.34	.00	19.75
7.	6.19	2.07	2.87	.95	5.01	.00	17.08
8.	5.16	1.06	1.15	.44	8.65	.00	16.45
9.	2.68	.47	.91	.02	7.21	.00	11.29
10+	1.34	.57	.13	.03	6.51	3.28	11.85
TOTAL	33.71	18.62	9.64	6.04	28.72	3.28	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7399	59.7	94.7	81.2	96.5	76.9	92.2	6.76
PREDICTED O.N.				89.7	97.2	81.6	90.7	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED REGULAR AREA 8

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.18	.00	.00	.00	.00	.18
4.	2.18	10.03	.00	.33	.00	.00	12.54
5.	9.06	6.25	.57	2.00	.00	.00	17.88
6.	8.21	3.79	3.54	1.33	1.36	.00	18.23
7.	5.60	2.05	3.29	.88	4.26	.00	16.08
8.	3.66	.93	.97	.47	6.74	.00	12.77
9.	2.36	.55	1.07	.03	5.24	.00	9.26
10+	1.66	.83	.13	.04	6.34	4.06	13.06
TOTAL	32.74	24.62	9.57	5.07	23.94	4.06	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7263	63.3	91.5	80.6	96.1	76.5	92.1	6.55
EDICTED O.N.				89.3	96.9	81.4	90.7	

Table 17-1

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED PREMIUM AREA 1

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.16	.00	.00	.00	.00	.16
4.	1.66	6.23	.00	.21	.00	.00	8.09
5.	12.10	5.37	.39	1.12	.00	.00	18.97
6.	10.00	2.94	2.23	1.11	.97	.00	17.25
7.	7.61	1.54	1.88	.53	5.48	.00	17.04
8.	11.04	.76	.99	.39	5.78	.00	18.96
9.	2.76	.35	.78	.02	5.20	.00	9.11
10+	1.57	.51	.14	.03	5.33	2.85	10.41
TOTAL	46.74	17.85	6.42	3.40	22.75	2.85	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7226	64.3	93.4	82.1	97.9	78.5	94.3	6.44
PREDICTED O.N.				90.2	98.4	82.3	92.3	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED PREMIUM AREA 2

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.19	.00	.00	.00	.00	.19
4.	2.67	8.37	.00	.41	.00	.00	11.45
5.	9.26	6.47	.48	1.76	.00	.00	17.97
6.	9.29	3.66	1.63	1.19	1.17	.00	16.93
7.	6.27	1.73	1.47	.54	4.06	.00	14.07
8.	8.21	.91	.94	.40	7.64	.00	18.09
9.	2.20	.47	.81	.01	7.80	.00	11.30
10+	1.42	.50	.12	.01	5.10	2.84	10.00
TOTAL	39.31	22.31	5.45	4.32	25.78	2.84	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7239	64.0	92.1	82.1	97.5	78.4	94.0	6.56
PREDICTED O.N.				90.2	98.0	82.3	92.1	

Table 17-2

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED PREMIUM AREA 3

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.13	.00	.00	.00	.00	.13
4.	1.44	8.90	.00	.27	.00	.00	10.61
5.	10.24	4.84	.36	1.74	.00	.00	17.18
6.	8.97	2.66	1.46	1.48	.78	.00	15.34
7.	8.28	1.24	1.36	.64	4.28	.00	15.81
8.	11.92	.56	.90	.34	7.47	.00	21.20
9.	2.33	.23	.70	.02	5.82	.00	9.09
10+	1.55	.39	.09	.00	5.44	3.18	10.65
TOTAL	44.73	18.94	4.88	4.49	23.79	3.18	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7231	64.2	93.3	85.3	99.9	81.6	96.4	6.47
PREDICTED O.N.				92.0	100.0	83.8	93.9	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED PREMIUM AREA 4

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.05	.00	.00	.00	.00	.05
4.	1.14	9.65	.00	.40	.00	.00	11.19
5.	9.12	4.13	.27	1.65	.00	.00	15.17
6.	6.63	1.71	1.41	1.20	.54	.00	11.49
7.	12.98	1.34	1.20	.47	3.76	.00	19.75
8.	18.53	.67	.71	.23	5.56	.00	25.70
9.	2.64	.30	.88	.01	3.92	.00	7.76
10+	2.53	.35	.18	.00	3.80	2.04	8.89
TOTAL	53.57	18.21	4.66	3.96	17.57	2.04	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
L AR CALC.	.7124	67.1	93.8	84.1	99.4	81.0	96.7	6.18
PREDICTED O.N.				91.3	99.6	83.5	94.1	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED PREMIUM AREA 5

	---PARAFFIN---						
CARBON	ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.08	.00	.00	.00	.00	.08
4.	1.15	8.39	.00	.29	.00	.00	9.84
5.	9.73	6.74	.48	1.98	.00	.00	18.94
6.	9.38	3.34	1.42	1.58	.97	.00	16.69
7.	7.14	1.64	1.26	.70	4.46	.00	15.20
8.	9.88	.74	.99	.37	7.47	.00	19.44
9.	2.58	.32	.54	.02	6.86	.00	10.32
10+	1.35	.42	.12	.00	5.54	2.08	9.49
TOTAL	41.21	21.67	4.80	4.94	25.30	2.08	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7235	64.1	92.5	83.0	98.2	79.3	94.6	6.54
PREDICTED O.N.				90.7	98.6	82.7	92.6	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED PREMIUM AREA 6

	---PARAFFIN---						
CARBON	ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.27	.00	.00	.00	.00	.27
4.	1.34	9.51	.00	.89	.00	.00	11.74
5.	8.31	3.69	.24	2.48	.00	.00	14.73
6.	6.33	2.10	1.21	1.82	.44	.00	11.90
7.	10.39	1.70	1.27	1.03	3.55	.00	17.94
8.	16.57	1.15	1.06	.38	6.00	.00	25.17
9.	3.10	.48	.96	.03	4.11	.00	8.69
10+	2.36	.47	.09	.02	4.23	2.41	9.57
TOTAL	48.41	19.37	4.84	6.65	18.33	2.41	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7147	66.5	93.7	82.2	97.7	78.7	94.6	6
PREDICTED O.N.				90.2	98.2	82.4	92.6	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED PREMIUM AREA 7

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.15	.00	.00	.00	.00	.15
4.	1.66	5.97	.00	.62	.00	.00	8.25
5.	9.76	3.80	.46	2.00	.00	.00	16.03
6.	9.21	2.54	3.45	1.30	1.16	.00	17.67
7.	8.98	1.48	2.72	.56	5.74	.00	19.49
8.	7.78	.73	.77	.27	9.03	.00	18.58
9.	2.00	.32	.57	.00	6.83	.00	9.72
10+	1.52	.33	.22	.02	5.64	2.40	10.12
TOTAL	40.92	15.32	8.20	4.77	28.40	2.40	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7349	61.0	93.7	84.5	99.1	80.3	95.0	6.74
PREDICTED O.N.				91.5	99.3	83.1	92.9	

DUPONT-GCOP

VOL. % HYDROCARBONS TO 424 F - SUMMARY

DUPONT 1978-79 WINTER SURVEY LEADED PREMIUM AREA 8

CARBON	---PARAFFIN--- ISO	NORMAL	NAPH.	OLEFIN	AROMATIC	UNKNOWN	TOTAL
3.	.00	.12	.00	.00	.00	.00	.12
4.	2.06	10.63	.00	.20	.00	.00	12.90
5.	9.58	4.33	.41	2.40	.00	.00	16.72
6.	8.32	2.45	2.20	1.54	1.20	.00	15.71
7.	9.22	1.40	1.65	.61	5.33	.00	18.21
8.	8.29	.77	.97	.33	9.01	.00	19.37
9.	1.93	.32	.57	.02	6.41	.00	9.25
10+	1.35	.23	.08	.02	4.65	1.40	7.72
TOTAL	40.76	20.25	5.88	5.11	26.60	1.40	100.00

	SPG	API	M.W.	RON0	RON3	MON0	MON3	C/H
LINEAR CALC.	.7236	64.0	90.7	85.7	100.0	81.6	96.2	6.64
:DICTED O.N.				92.2	100.1	83.8	93.8	

Appendix 1

E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED
PETROLEUM LABORATORY
WILMINGTON DELAWARE 19898

TELEPHONE
AREA CODE 609-299-5000

February 26, 1979

Mr. Richard W. Hurn
United States Department of Energy
Bartlesville Energy Research Center
Post Office Box 1398
Bartlesville, Oklahoma 74003

Dear Dick,

I am pleased to offer the following proposal for analyzing gasoline samples collected in our 1978-1979 Winter Road Octane Survey. If you wish, we would be willing to analyze samples from our 1979 Summer Survey.

Individual gasolines from our survey, which would include samples from Salt Lake City and Seattle, will be composited into larger samples for analysis. Unless you have further instructions, the compositing will be carried out as described to you in my February 23, 1979 letter. The fraction of a given company's gasoline sample used to prepare each area composite sample will be based on the company's market share in the states covered by the area. A leaded regular, leaded premium, and an unleaded sample will be composited for each of the eight areas. A total of 24 samples will be analyzed for each survey.

The analyses for each sample will include C_3 to $C_{10}+$ hydrocarbons by gas chromatography, sulfur, lead in leaded samples, manganese in leaded samples, RVP, gum, distillation, specific gravity, and Research and Motor octane numbers.

Our charge for doing this work for you will be $46,274 per survey. A breakdown of this cost figure is as follows.

Program Supervision and Report Preparation	$6,000
Procurement of 5 Unleaded and 10 Leaded Samples in Salt Lake City	475
Procurement of 5 Unleaded and 10 Leaded Samples in Seattle	475
Preparation of 24 Composites	3,600

analytical data obtained for each gasoline so as to cumulate the quantitative data for each of the hydrocarbon components from C_3 to C_{10+} into the following five compositional classifications: isoparaffin, normal paraffin, naphthene, olefin, and aromatic. In addition, the report shall also provide the calculated values from the GLC data for specific gravity, molecular weight, and the research and motor octane numbers. The report shall further provide the usual analytical inspection data used to characterize the quality of motor gasolines including gum content, Reid Vapor pressure, distillation (ASTM D-86), specific gravity, research octane number, motor octane number, and lead content. Additionally, analytical information shall be provided for sulfur content of both leaded and unleaded gasolines and for manganese content of unleaded gasolines.

SECOND: At DOE's option, the Contractor shall provide an identical set of information based on analyses of gasoline samples taken in the 1979 summer survey at a price of $46,274. DOE will notify the Contractor of the Department's intent to exercise this option on or by 10/01/79.

THIRD: Fifteen copies of a final report will be delivered to R. W. Hurn, BETC/DOE, P. O. Box 1398, Bartlesville, OK 74003.

The data to be provided to DOE in the report to be furnished by the Contractor hereunder shall be used by DOE to characterize the chemical make-up of gasolines currently marketed in the mainland United States and to compare the chemical make-up of these fuels with that of gasolines which would be most compatible with methanol.

The results of this report will identify the current state of the art technology in fuel processing to produce fuels that meet regular and premium grade gasoline specifications. If and when alcohol fuels enter the market place, this baseline information would be useful in determining how the base fuels might be reformulated to accomodate the addition of alcohol. (i.e., to maintain a specified vapor lock index, some light hydrocarbons might have to be removed from the base gasolines before the alcohol can be added.)

FOURTH: The total dollar amount of contract is changed as follows:

From:	$61,680.00
To:	$107,954.00
Increase Of:	$46,274.00

FIFTH: The planned completion date for the analyses is July 1, 1979.

SIXTH: All other terms and conditions remain the same.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1979—671-073/ 4R

Department of Energy
Bartlesville Energy Technology Center
P.O. Box 1398
Bartlesville, Oklahoma 74003

June 14, 1979

E. I. du Pont de Nemours & Co.
Petroleum Laboratory
Wilmington, DE 19898

Gentlemen:

Enclosed are three copies of Modification A002 of Contract EW-78-C-19-0012, dated April 24, 1978.

Please have the copies signed by a person with authority to bind your company and return all copies to the undersigned.

A fully executed copy will be returned to you for your files.

Sincerely,

William C. Drake
Contracting Officer

Enclosures

STANDARD FORM 30, JULY 1966
GENERAL SERVICES ADMINISTRATION
FED. PROC. REG. (41 CFR) 1-16.101

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

PAGE 1 OF 2

1. AMENDMENT/MODIFICATION NO.	2. EFFECTIVE DATE	3. REQUISITION/PURCHASE REQUEST NO.	4. PROJECT NO. (If applicable)
A002	06/14/79		

5. ISSUED BY — CODE

U.S. Department of Energy
Bartlesville Energy Technology Center
Virginia & Cudahy Streets
Bartlesville, OK 74003

6. ADMINISTERED BY (If other than block 5) — CODE

7. CONTRACTOR NAME AND ADDRESS (Street, city, county, state, and ZIP Code) — CODE: — FACILITY CODE:

E. I. du Pont de Nemours & Co.
Petroleum Laboratory
Wilmington, DE 19898

8.
☐ AMENDMENT OF SOLICITATION NO. _____,
DATED _____ (See block 9)
☒ MODIFICATION OF CONTRACT/ORDER NO. EW-78-C-19-0012
DATED 04/24/78 (See block 11)

9. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in block 12. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.

Offerors must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended, by one of the following methods:

(a) By signing and returning _____ copies of this amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If, by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided such telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

10. ACCOUNTING AND APPROPRIATION DATA (If required)

INCREASE OBLIGATION $46,274.00

11. THIS BLOCK APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS

(a) ☐ This Change Order is issued pursuant to _____.
The Changes set forth in block 12 are made to the above numbered contract/order.

(b) ☐ The above numbered contract/order is modified to reflect the administrative changes (such as changes in paying office, appropriation data, etc.) set forth in block 12.

(c) ☒ This Supplemental Agreement is entered into pursuant to authority of 41 U.S.C. 252(c)(10)
It modifies the above numbered contract as set forth in block 12.

12. DESCRIPTION OF AMENDMENT/MODIFICATION

FIRST: The Contractor shall provide samples of regular and premium grade gasolines deemed by the Contractor to be representative of those currently marketed in the United States for a detailed hydrocarbon characterization using gas chromatography.

The gasoline samples (approximately 200) shall be composited to give a proper statistical representation of the sales weighted composition for a particular survey site.

The Contractor shall perform such chromatographic analyses on each of the gasoline samples and shall within 180 days after the effective date hereof deliver to DOE 10 copies of a report which shall provide, as hereinafter more particularly described, certain information with respect to each of the gasolines to be subjected to analyses described hereunder.

The analytical data to be provided in the report shall indicate the content by volume of hydrocarbon components of from 3 to 10+ carbon atoms per molecule and, depending upon the gasoline being subjected to analysis, will typically identify and measure approximately 100 or more of the various constituent compounds (or mixtures of nearly identical properties). The report shall also reduce the

Except as provided herein, all terms and conditions of the document referenced in block 8, as heretofore changed, remain unchanged and in full force and effect.

13. ☐ CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT ☒ CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN 2 COPIES TO ISSUING OFFICE

14. NAME OF CONTRACTOR/OFFEROR		17. UNITED STATES OF AMERICA	
BY _____ (Signature of person authorized to sign)		BY _____ (Signature of Contracting Officer)	
15. NAME AND TITLE OF SIGNER (Type or print)	16. DATE SIGNED	18. NAME OF CONTRACTING OFFICER (Type or print)	19. DATE SIGNED
		William C. Drake	

Gas Chromatographic Analysis of 24 Samples (1 Determination @ $625 each)	$15,000
Sulfur Analysis of 8 Unleaded and 16 Leaded Samples	3,500
Manganese Analysis on 16 Leaded Samples (2 Determination/sample, @ $16/Determination)	512
Lead Analyses on 16 Leaded Samples (2 Determinations/sample, @ $16/ determination)	512
Gum Analyses on 24 Samples (2 Determinations/sample, @ $70/ Determination)	3,360
RVP Analyses on 24 Samples (2 Determinations/sample, @ $45/ Determination)	2,160
Distillation on 24 Samples (2 Determinations/sample, @ $70/ Determination)	3,360
Specific Gravity on 24 Samples (1 Determination @ $10/sample)	240
Research and Motor Octane Numbers on 24 Samples (2 Determinations/ O.N., @ $30/Determination)	2,880
Contingency (10%)	4,230
Total per Survey	$46,274

We would expect to complete the 1978-1979 Winter Survey gasoline analyses by June 15, 1979 and the Summary Survey by November 30, 1979. Your early indication of whether you plan to proceed with this work is needed since we will need to pick up samples in the Seattle and Salt Lake City area before the winter season is over.

If the above arrangements are satisfactory to you, please let me know so we may begin work.

Very truly yours,

Emmett S. Jacobs
Research Manager

UNITED STATES DEPARTMENT OF ENERGY
BARTLESVILLE ENERGY TECHNOLOGY CENTER
P.O. BOX 1398
BARTLESVILLE, OKLAHOMA 74003

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DEPARTMENT OF ENERGY

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